We claim:

1. A method of detecting apoptotic cells in a cellular sample, comprising the steps of obtaining a cellular sample; contacting the cellular sample with a solution comprising a nucleic acid molecule and a topoisomerase I enzyme, the nucleic acid molecule being cleavable by the topoisomerase I enzyme and ligatable to a 5'OH; and detecting the nucleic acid molecule ligated to a 5'OH of the DNA of the cellular sample, wherein the detection of the nucleic acid molecule ligated to a 5'OH of the DNA of the cellular sample correlates to the presence of apoptotic cells.

2. The method of claim 1 wherein the cellular sample is a tissue section.

3. The method of claim 1 further comprising the step of fixing the cellular sample.

4. The method of claim 1 wherein the nucleic acid molecule comprises a detectable label.

5. The method of claim 4 wherein the detectable label is selected from the group consisting of enzymes, small molecules, chromophores, fluorophores and radiolabeled materials.

6. The method of claim 4 wherein the detectable label is a fluorophore.

7. The method of claim 4 wherein the detectable label is FITC.

8. The method of claim 1 wherein the detecting is by microscopy.

9. The method of claim 1 wherein the nucleic acid molecule has a recognition site for an endonuclease.

10. The method of claim 1 wherein the topoisomerase I enzyme is vaccinia DNA topoisomerase I.

11. The method of claim 1 wherein the 5' OH is at an overhang.

12. The method of claim 1 wherein the 5' OH is at a recessed end.

13. The method of claim 11 wherein the nucleic acid molecule has a recognition site 2 to 10 nucleotides from the 3' end of the oligonucleotide duplex.

14. The method of claim 1 wherein the 5' OH is at a blunt end.

15. The method of claim 1 wherein the nucleic acid molecule has a topoisomerase I enzyme recognition site and a nick in the opposite strand of DNA.

16. The method of claim 15 wherein the topoisomerase I enzyme recognition site is 5'-CCCTT-3' (SEQ ID NO: 4).

17. The method of claim 15 wherein the nick in the opposite strand of DNA is directly opposite of the point of cleavage at the recognition site.

18. The method of claim 15 wherein cleavage of the nucleic acid molecule by topoisomerase I forms nucleic acid molecule A and nucleic acid molecule B.

19. The method of claim 18 wherein the solution further comprises a nucleic acid ligase enzyme, wherein nucleic acid molecule B is ligatable to a 5'PO_4 and detection of nucleic acid molecule A ligated to a 5'OH of the cellular sample and nucleic acid molecule B ligated to a 5'PO_4 of the cellular sample correlates to the presence of apoptotic cells.

20. The method of claim 19 wherein the 5' OH is at an overhang.

21. The method of claim 19, wherein the 5' OH is at a recessed end.

22. The method of claim 19 wherein the 5' OH is at a blunt end.

23. The method of claim 19 wherein nucleic acid molecule A and nucleic acid molecule B comprise detectable labels.

24. The method of claim 23 wherein the detectable labels are selected from the group consisting of enzymes, small molecules, chromophores, fluorophores and radiolabeled materials.

25. The method of claim 24 wherein one detectable label is FITC and the other detectable label is rhodamine.

26. The method of claim 19 wherein the nucleic acid ligase enzyme is T4 DNA ligase.

27. A method of detecting apoptotic cells in a cellular sample comprising the steps of: isolating DNA from a cellular sample; contacting the DNA with a solution comprising a nucleic acid molecule and a topoisomerase I enzyme, the nucleic acid molecule being cleavable by the topoisomerase I enzyme and ligatable to a 5'OH; and detecting the nucleic acid molecule ligated to a 5'OH of the DNA, wherein the detection of the nucleic acid molecule ligated to a 5'OH of the DNA correlates to the presence of apoptotic cells.

28. The method of claim 27 wherein the nucleic acid molecule comprises a detectable label.

29. The method of claim 28 wherein the detectable label is selected from the group consisting of enzymes, small molecules, chromophores, fluorophores and radiolabeled materials.

30. The method of claim 28 wherein the detectable label is a fluorophore.

31. The method of claim 28 wherein the detectable label is FITC.

32. The method of claim 27 wherein the detecting is by gel electrophoresis.

33. The method of claim 27 wherein the nucleic acid molecule has a recognition site for an endonuclease.

34. The method of claim 27 wherein the topoisomerase I enzyme is vaccinia DNA topoisomerase I.

35. The method of claim 27 wherein the 5' OH is at an overhang.

36. The method of claim 27 wherein the 5' OH is at a recessed end.

37. The method of claim 35 wherein the nucleic acid molecule has a recognition site 2 to 10 nucleotides from the 3' end of the oligonucleotide duplex.

38. The method of claim 27 wherein the 5' OH is at a blunt end.

39. The method of claim 27 wherein the nucleic acid molecule has a topoisomerase I enzyme recognition site and a nick in the opposite strand of DNA.

40. The method of claim 39 wherein the topoisomerase I enzyme recognition site is 5'-CCCTT-3' (SEQ ID NO: 4).

41. The method of claim 39 wherein the nick in the opposite strand of DNA is directly opposite of the point of cleavage at the recognition site.

42. The method of claim 39 wherein cleavage of the nucleic acid molecule by topoisomerase I forms nucleic acid molecule A and nucleic acid molecule B.

43. The method of claim 42 wherein the solution further comprises a nucleic acid ligase enzyme, wherein nucleic acid molecule B is ligatable to a $5'PO_4$ and detection of nucleic acid molecule A ligated to a 5'OH of the DNA and nucleic acid molecule B ligated to a $5'PO_4$ of the DNA correlates to the presence of apoptotic cells.

44. The method of claim 43 wherein the 5' OH is at an overhang.

45. The method of claim 43 wherein the 5' OH is at a recessed end.

46. The method of claim 43 wherein the 5' OH is at a blunt end.

47. The method of claim 43 wherein the nucleic acid molecule A and nucleic acid molecule B comprise detectable labels.

48. The method of claim 47 wherein the detectable labels are selected from the group consisting of enzymes, small molecules, chromophores, fluorophores and radiolabeled materials.

49. The method of claim 48 wherein one detectable label is FITC and the other detectable label is rhodamine.

50. The method of claim 43 wherein the nucleic acid ligase enzyme is T4 DNA ligase.